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Intervisibility and Intravisibility of rock feature sites: a method for testing viewshed within and outside the socio-spatial system of the Lower Fraser River Canyon, British Columbia

Kisha Supernant*

Department of Anthropology, University of Alberta, 13-15 HM Tory, Edmonton, AB, T6G 2H4, Canada

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ABSTRACT

Visibility analysis has been used in archaeology to understand the significance of built environment and local topography to ancient peoples. In this study, visibility analysis of both an inhabitant view of the landscape and an outsider view are examined, testing whether landscape features are built for either internal or external signalling. The method is applied to a series of built rock features in the socio-spatial system of the Lower Fraser River Canyon, BC. Viewshed measurements are taken both from rock feature locations and to rock feature locations from the main route of travel through the area: the Fraser River. The results of the analysis indicate that external visibility was a greater concern at the entrance to the territory and internal visibility was emphasized further upriver. Overall, neither internal nor external signalling was the singular purpose behind building rock feature sites in this region.

1. Introduction

Analysing the intervisibility of archaeological settlements, buildings, and monuments has been an increasingly popular GIS method to apply to archaeological data since the mid-1990s (Fisher, 1994; Wheatley, 1995). While the first attempts to query the visibility of landscape forms and ancient settlements were limited in scope (Gaffney and Stancic, 1991; Krist and Brown, 1994; Lake and Woodman, 2003), the method has become more nuanced in the past twenty years, addressing social questions of perception, viewscapes, and the challenges of applying analysis of human experience to static digital data (Fitzjohn, 2007; Ogburn, 2006; Thomas, 2004; Tilley and Bennett, 2004). Whether or not an object, monument, landform or building was visible to past inhabitants of landscapes have been used to infer ritual power (Bongers et al., 2012; Doyle et al., 2012; Mantha, 2009), meaning (Fitzjohn, 2007), and defense (Sakaguchi et al., 2010; Smith and Cochrane, 2011). Landscape perception in the past, however, would have differed depending on an individual's relationship to socio-spatial context, for “as members of social groups, individuals negotiated their interests and manipulated their socio-spatial world” (Knapp and Ashmore, 1999:17). For example, visitors travelling into new or unknown territory might not have known the significance of landscape markers for navigation that made the route safe for inhabitants. Visible landscape markers, such as stone monuments or other built structures, would have been interpreted differently by people living in the landscape and people who did not belong (Tilley, 1996). Differing knowledge of the landscape may have been operationalized or enhanced by inhabitants to their advantage.

In this paper, a combination of viewshed methods is used to test different elements of visibility that may correspond to internal vs. external social encounters. Visibility is often used to discuss internal (e.g., monumentality and sacred landscapes) or external factors (e.g., defensibility), but rarely is combined to explore both perspectives and evaluate the audience for certain landscape or built environment features (but see Alejandro, 2013). A foundational assumption to this study is that belonging to a socio-spatial creates a different experience of the landscape than being outside of a socio-spatial system. Familiarity with the landscape changes the ways in which the built environment is perceived by people (Knapp and Ashmore, 1999). Thus features that are built for an internal audience (for example, to mark difference or similarity between people within the social group) will have measurably different

* Tel.: +1 780 492 7345.
E-mail address: kisha.supernant@ualberta.ca.

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visibility qualities than those built to be perceived primarily by outsiders. Previous archaeological applications of visibility have assumed that the investment in sites on the landscape is designed either to signal to people moving through the landscape, to defend against intruders, or to serve some ritual purpose (Bongers et al., 2012; Doyle et al., 2012; Mantha, 2009; Sakaguchi et al., 2010). The current study demonstrates that the same type of built landscape feature can have different visibilities and potentially different audiences, indicating that the placement of features may be more important than the form of the feature itself.

A case study from the archaeological record of the Lower Fraser River Canyon, British Columbia provides data to explore how visibility of landscape features from two different perspectives has the potential to illuminate patterns of landscape modification in the region. For the inhabitant/kin perspective on the visible landscape, the intervisibility of sites with rock architecture in the Lower Fraser River Canyon is measured and compared, exploring the possible existence of a social network established for communication and defense, as originally hypothesized by Schaepe (2006). For a visitor or enemy perspective on the same landscape, the visibility of rock features from the river is measured and compared. The results of the visibility analysis are used to query whether rock features were built to be seen from the primary route of travel through the Canyon or whether they were built to be seen from other sites with rock features, or both. Did intervisibility influence where individuals or groups built rock features on the landscape? Were they built to be seen by travellers or by other inhabitants? The purpose of the study is to test the visibility of built landscape features, based on the assumption that features meant to be seen from the main route of travel, in this case the Fraser River, were built for external purposes, while features not visible from the river but visible between village sites were built for internal purposes. Viewshed analysis is used to analyse whether features are built to be seen from either villages or the river, or both. In addition, the overall visibility of the landscape is compared with the locations where features are located to test whether these features were built in areas of high visibility from the river. The Lower Fraser River Canyon is an ideal landscape in which to test questions about internal and external socio-spatial signalling because it is located in a spatial system where there is a clear entrance and exit to the territory and there is a defined path of travel via the river. Similar analyses would be appropriate in locations where travel routes are clearly defined and built landscape features are present on which to test visibility.

First, the significance of the Lower Fraser River Canyon as a locus of social activity and aggregation among the Coast Salish of British Columbia is discussed. The Canyon is home to constructed rock terraces and walls that are unusual on the Northwest Coast of North America, where the majority of building was done with wood. The rock features form the dataset for viewshed analysis. Next, the approaches to the two different perspectives of viewshed applied to these data are discussed and the results of both the internal and external analyses are presented. Finally, the implications of the results for understanding how external and internal social relationships may have been embedded within the built landscape of the Lower Fraser River Canyon are considered.

2. Background: The Lower Fraser River Canyon

The Lower Fraser River Canyon (the Canyon) is located in southwestern British Columbia along the Fraser River drainage (Figs. 1 and 2). The Canyon was an area where thousands of people aggregated for several months each summer at the height of the fishing season, a pattern which was observed by some of the first Europeans to travel through the area and likely extended into deep history (Carlson, 2007; Schaepe, 2001). The Canyon was the ideal location to catch tens of thousands of salmon from one of western North America's largest salmon rivers and wind-dry them for preservation through the winter months (Carlson, 2001a) and was therefore an attractive place for inhabitants and visitors alike.

The steep-sided and rocky nature of the Fraser Canyon did not allow for a large permanent occupation, and most habitable spots show evidence of extensive use and modification, in some cases stretching back nearly 10,000 years (Mitchell and Pokotylo, 1996). During the late pre-contact period (1000 BP-300 BP), this area was densely populated with inhabitants living in winter villages (Schaepe, 2006). However, for a few months during the summer salmon fishing season, it was transformed into a major nexus of interaction (Carlson, 2001b). Early journal accounts describe Coast Salish communities coming to the Canyon from as far away as Vancouver Island, approximately 250 km away (Carlson, 2007; MacLachlan, 1998). The complex social interactions that took place in this landscape make it an ideal location to try to determine whether landscape features were designed for an internal or external audience. Inhabitants of the landscape are defined as individuals or families with permanent places of occupation or ownership of locations within the region for all or a portion of the year. Close kin are defined as individuals or families which may be welcome in the territory for certain purposes at specific times, including relations of inhabitants, even if they did not have permanent residences. Kin may occupy a space in between binary categories of inside or outside, since they would have internal access to the socio-spatial system. Strangers are defined as friendly visitors with no kin relations. In other locations, the definitions between insider/outsider may be different. Inhabitants of the socio-spatial system are defined as the people who lived in the winter villages or who owned rights of access to fish at specific sites in the Canyon year after year, visitors as people who gained access via negotiation, and strangers as people who did not belong in the Canyon. Other socio-spatial systems might have different, culturally specific rules about who could gain entrance, subsequently influencing how landscapes were modified to signal to different groups within their society.

A link exists between the intensive use of the Canyon for salmon fishing by large groups of people and how the landscape was modified in antiquity. The Canyon was modified through the construction of permanent, monumental rock features, including walls, terraces and house platforms (Fig. 3), that are not found further downriver. These are typically between 2 and 10 m in length, with a few longer than 100 m. On average, rocks used in these features range from 0.5 to 1 m in size and were generally gathered from local bedrock outcrops, so most look quite similar in form and material. Most stones used to build the features are angular with many flat edges that were used strategically to enhance stability of features. The dry masonry construction ranged from loosely stacked to tightly stacked, and there was extensive use of chinking, a practice of using small rocks to stabilize larger rocks, or to fill in gaps that might negatively impact the overall stability of the features. In addition, most of the rock features were terraces, built to create stable, level areas in an otherwise very steep landscape. Features range from 300 m^2 terraces 50 m above mean river level to small, semi-circular stone enclosures, less than 2 m^2, subject to yearly inundation by seasonal changes in the river level. Some consist of hundreds of rocks, while one feature is constructed from only nine large boulders and a few small rocks use to stabilize larger rocks. Rock features tend to cluster at known winter village locations but do appear elsewhere on the landscape, and over 100 individual features have been identified in the region. The features have not all been dated, but dendrochonological analysis places the abandonment of some features prior to contact (Schaepe et al., 2006) and

Fig. 1. Map of southern British Columbia showing study area.

lithic materials are present in many of the features. The construction of the rock features most likely dates to within the past 1000 years of occupation, although further work is need to refine their chronology and establish whether the sites with rock features are contemporaneous. Whether or not they were built at the same time, they were most likely all present in the Canyon during the late pre-contact period, based on current research (Schaepe, 2006). The Canyon, however, has been subject to considerable disturbance over the past 150 years, including the building of a major highway and two railways. It is unclear how many rock features may have been present on the landscape prior to these impacts.

One of the theories about the placement of the rock features in the Canyon was presented by Schaepe (2006), who hypothesised that the rock features formed a network of intervisibility, indicating social cohesion within the Canyon in the late pre-contact period. This hypothesis is tested below. For the analysis, a sample of mapped 25 rock features is used (Supernant, 2011), most of which cluster at known winter village locations occupied in the late pre-contact period. The sample is used to test which sites can be seen from other sites with rock features and which features at those sites are visible from the river using viewshed analysis.

Fig. 2. The Lower Fraser River Canyon.

3. Theory of viewshed analysis

Viewshed analyses use algorithms in a GIS environment to analyse spatial data in raster form, in which spatial information is coded in a series of cells forming a grid, such as digital elevation model data (Fisher, 1994; Lake and Woodman, 2000). The algorithms can be used to calculate the field of view from a particular cell that contains spatial information about the area within that cell, and to determine the line-of-sight or intervisibility of two or more locations on that raster. Since viewshed is based on a mathematical representation of the landscape, this method does not account for a variety of different elements within that landscape, including height of the observer, curvature of the earth, and vegetation (Conolly and Lake, 2006). Most GIS programs, such as ArcGIS 10.2, now provide tools to account for these variables. From an archaeological perspective, viewshed can been used to determine whether two sites are intervisible, or whether a certain prominent landscape feature, either natural or cultural, can be seen by individuals located at various points on the landscape (Llobera, 2001; Wheatley and Gillings, 2000). Intervisibility between sites and the prominence of built features can illuminate two different perceptions of the landscape; therefore, analyses of both of these perspectives are applied here to rock feature sites in the Lower Fraser River Canyon.

Viewshed analyses, instead of providing firm answers to archaeological questions, might best be considered a form of exploratory data analysis (Aldenderfer and Maschner, 1996), allowing for exploration of spatial relationships between landscape features that might otherwise be obscured or imperceptible. Greater processing power and the availability of both GIS software and multi-processor computers has led to a widespread adoption of what is sometimes termed a push-button viewshed analysis that can provide results without critical engagement with the underlying issues of the assumptions made in the process (Wheatley and Gillings, 2000). Many recent archaeological applications of viewshed have grappled with the implications of the assumptions (Conolly and Lake, 2006; Gillings, 2009; Llobera, 1996, 2001, 2003, 2007; Mitcham, 2002; Ogburn, 2006; Wheatley and Gillings, 2000),

Fig. 3. Example of a rock feature in the Lower Fraser River Canyon.

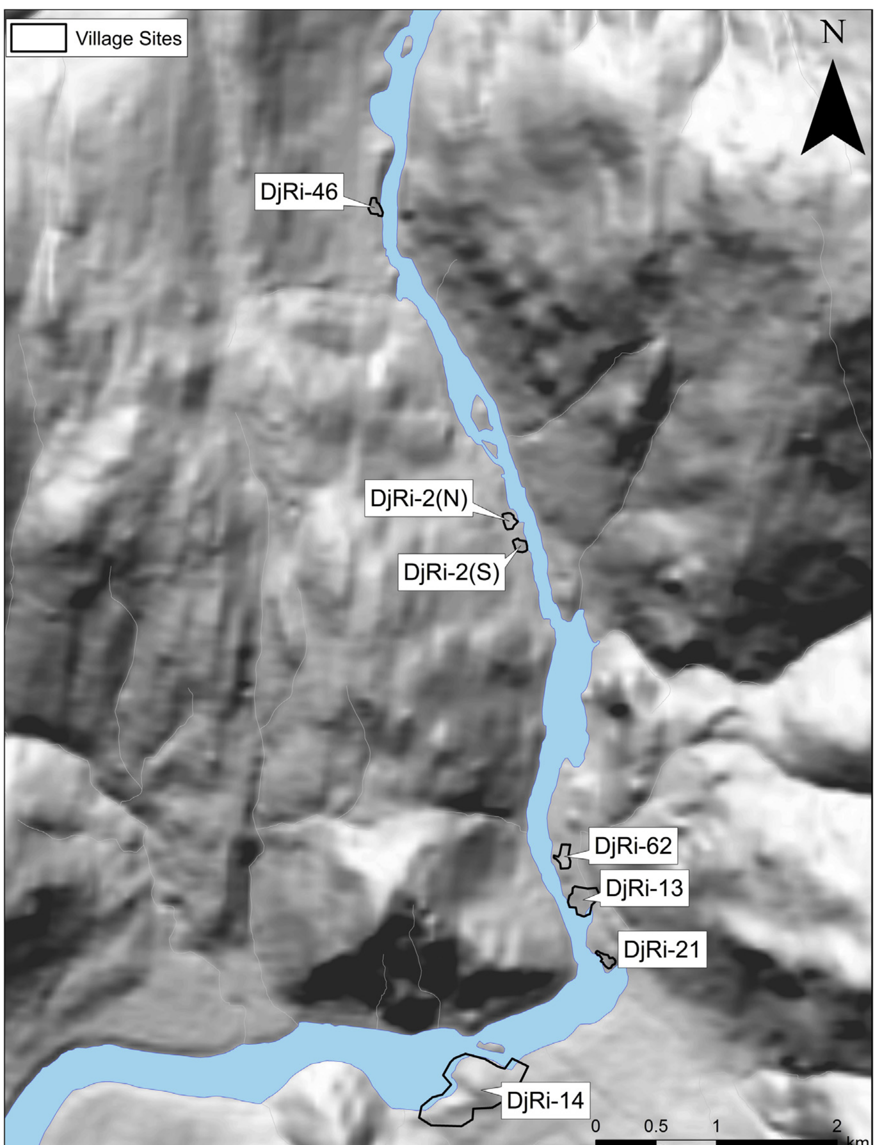

Fig. 4. Location of mapped village locations in the Lower Fraser River Canyon.

with authors proposing a number of refinements to the initial attempts at viewshed. Fuzzy viewsheds have recently been reviewed by Ogburn (2006), who argues that we need to consider the limits of human vision and acuity, following the observations of Trifković (2006) and Higuchi (1983). A more complex method of GIS, however, is not necessarily the most effective tool in all research contexts (Gillings, 2009).

The study area within the Canyon is approximately 4 km long, so the limitations of human vision are not a significant concern. Nevertheless, some rock features are quite small and possibly difficult to distinguish from the surrounding topography from far away. Cumulative viewsheds, distance categories, and a comparison between rock feature and non-rock feature locations are used to refine the analysis. Distance thresholds serve to distinguish between sites where individual features could be perceived and sites which may have been intervisible but where the viewer may not have distinguished small rock features. Since the rock features are constructed out of the same material that is found throughout the Canyon, the rock features may not have been visually distinguishable from longer distances.

To evaluate whether rock features may have been built as a signal to individuals outside of the established social system, a viewshed analysis is used to measure which village sites are visible from individuals at other village sites and which cells with rock features are visible from the direction of travel on the river. The viewshed analysis for individual rock features is limited to points downriver, since this would be the direction from which most visitors and enemies would approach the rock feature sites. If rock features fall into cells that are visible from downriver, it is possible that they were built in order to be seen by travellers, and rock features with greater visibility are more likely to have been perceived than those with less visibility, as measured by times seen in the cumulative viewshed. Thresholds are used to refine the analysis and distinguish between rock features that are only visible from points on the river directly adjacent to the sites and rock features that can be perceived from a greater distance.

4. Methods

Several steps are required to prepare data for viewshed analysis, including preparation of the DEM and the identification of important points on the landscape from which to measure viewshed. A Digital Elevation Model (DEM) point file was acquired for the Lower Fraser River from the British Columbia Provincial Government with a 25 m resolution.[1] A surface DTM at 25 m was created from the DEM points using Kriging geostatistical suite in ArcMap 10.2. While adequate for this analysis, the viewshed calculations would be more precise with greater spatial resolution and the results might change. The high level of elevation change within the study area contributes to the possible sources of error within the analysis. The STM was drawn in ArcMap 10.2 and visibility was calculated for a series of points from known village sites with rock features mapped in 2008 and 2009 using a Leica 705 Total Station and geo-rectified during post-processing. Village viewshed measures are based on between 2000 and 5000 individual points, rather than a single point for each location. Village locations are expected to have a great vertical accuracy (<5 m) than the underlying DEM. For viewshed measures from village sites, an elevation offset of 1.7 m

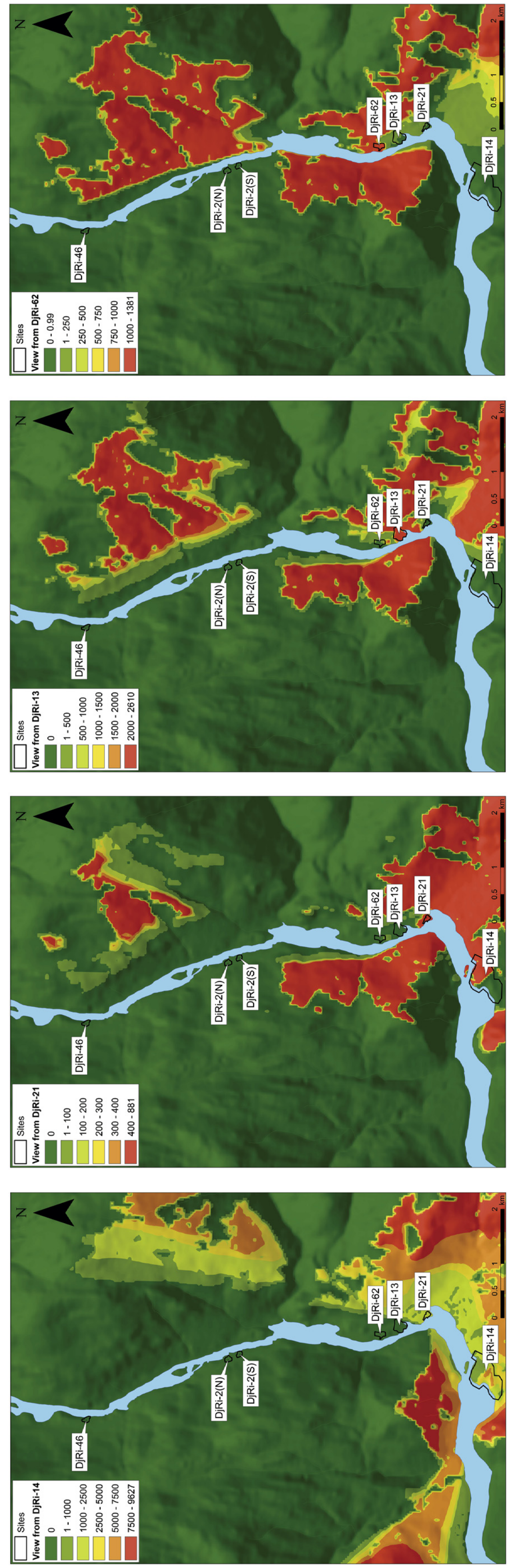

Fig. 5. Site viewsheds of Lower Canyon sites.

[1] The elevation data in the DEM are derived from the Terrain Resource Information Management through the Government of British Columbia. These data have a vertical accuracy of less than or equal to 10 m (http://geobc.gov.bc.ca/base-mapping/imagery/products/gridded.html).

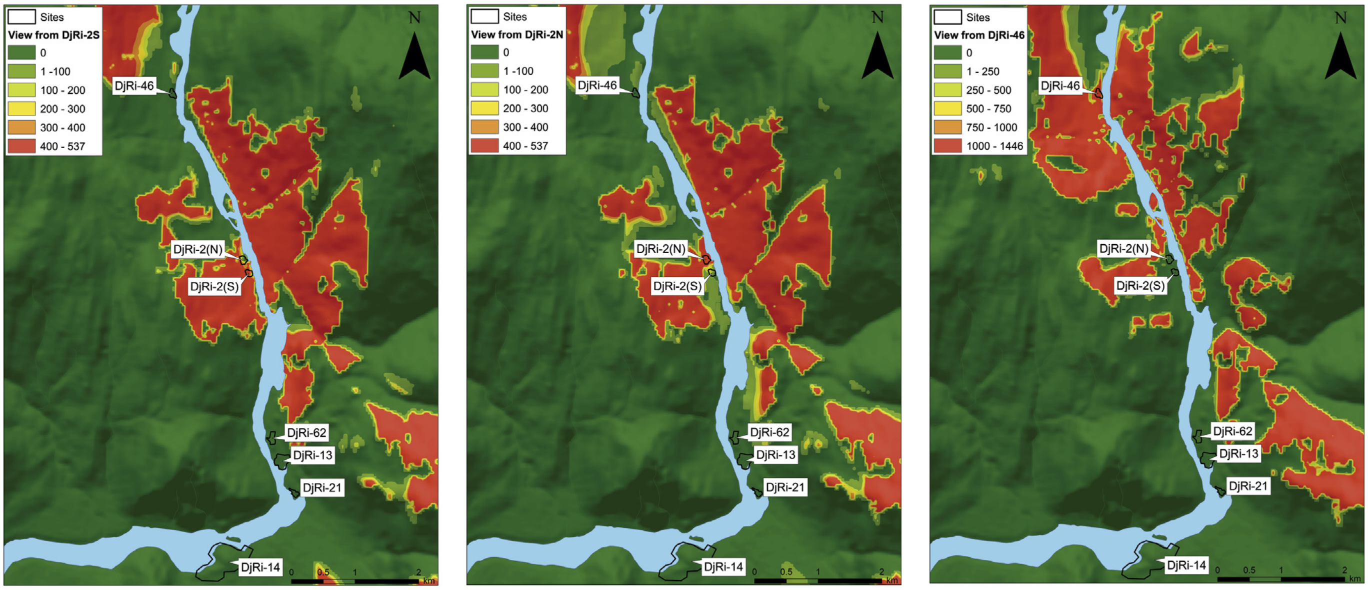

Fig. 6. Site viewsheds of Upper Canyon sites.

was used for origin and destination points to account for typical assumptions of the height of a standing observer (Conolly and Lake, 2006).

To avoid edge effects, where distortion can occur at the edges of the map, the maximum viewable radius was set to 5 km, as the greatest extent between village sites in the Canyon is approximately 4 km. No robust reconstructions of paleovegetation exist for the Canyon, so vegetation was not considered in this analysis. The current rocky nature of the Canyon suggests that vegetation may never have been dense near the edge of the water. In some areas, it appears likely that vegetation would not have obscured rock feature visibility, but more data are required before vegetation cover can be accounted for in the Canyon. A viewshed map was produced for each mapped site, showing a raster indicating areas of the landscape within view.

For the river view, a series of digital elevation points were generated from the same DEM used for the underlying surface. All points downriver from each mapped site were clipped and a viewshed analysis was run to see if rock features were visible from the downriver direction. The majority of travel for seasonal aggregation was from downriver (Schaepe, 2006) during the months of June–September (MacLachlan 1998), so the visibility of rock features was tested by focussing on views from the direction of travel. Offset was modified for the river view from 1.7 m to 0.5 m in order to account for individuals sitting in canoes travelling along the river. The rock features were not given an offset, because the question was whether the features themselves could be seen by travellers, regardless of whether people were on the landscape. In addition, a series of buffers were created around each site at 0–100 m, 101–500 m, 501–1000 m, 1001–2000 m, and 2000 + m. The buffers serve to evaluate at what distances rock features were in viewable range, as rock features viewable from further away from sites may have had a greater impact on visitors than features only visible from within 100 m of the site. A separate viewshed was run from river points in each of these buffer ranges: 0–100 m, 101–500 m, 501–1000 m, 1001–2000 m, and 2000 + m, resulting in five different viewsheds per rock feature site. The number of times seen was recorded for each visible rock feature to compare how visible different rock features were from downriver. In the

Table 1
Site intervisibility in the Lower Fraser River Canyon.

Site	DjRi-14	DjRi-21	DjRi-13	DjRi-62	DjRi-2(S)	DjRi-2(N)	DjRi-46
DjRi-14	–	Yes	Yes	No	No	No	No
DjRi-21	Yes	–	No	Yes	No	No	No
DjRi-13	Yes	Yes	–	Yes	No	No	No
DjRi-62	Yes	No	Yes	–	No	No	No
DjRi-2(S)	No	No	No	No	–	Yes	No
DjRi-2(N)	No	No	No	No	Yes	–	No
DjRi-46	No	No	No	No	No	Yes	–

Site	Other sites seen	Total cells seen	Percentage cells seen
DjRi-14	2	19,314	24.3%
DjRi-21	2	10,483	13.2%
DjRi-13	3	11567	14.6%
DjRi-62	2	11,419	14.4%
DjRi-2(S)	1	10,622	13.4%
DjRi-2(N)	1	10,441	13.1%
DjRi-46	1	9192	11.6%

Table 2
Summary of rock feature visibility from the river.

Site	Visible RF %	Visible RF#	Non-visible RF %	Non-visible RF#	Notes
DjRi-14	33%	1	67%	2	Only three rock features were recorded on this site as part of the project, although many more are present.
DjRi-13	60%	3	40%	2	
DjRi-62	50%	3	50%	3	This site is located in a forested area today, so vegetation may have influenced visibility
DjRi-2S	67%	2	33%	1	
DjRi-2N	50%	2	50%	2	
DjRi-46	50%	2	50%	2	Lack of visibility may be due to steepness of slope.
Total	52%	13	48%	12	

following discussion, the results are presented from both the village site viewshed analysis and the analysis of viewshed from the river.

5. Results

5.1. Site intervisibility

Seven total village sites were run to determine their intervisibility, six of which have rock features located within or directly adjacent to the village (Figs. 4–6). At least one other large winter village has been recorded in the Lower Fraser River Canyon, but without detailed mapping data, it could not be compared to the other villages and was excluded from this analysis. It is possible that inclusion of this village, once adequately mapped, would change the results of the line-of-sight analysis. Table 1 summarises the site locations where an individual standing at one site would be able to see an individual standing at another site.

A viewshed was calculated for each individual site and a site was considered to have visibility of another site if at least one or more cells within the boundary of another site were recorded as visible in the results. The sites in Tables 1 and 2 are arranged in order from furthest downriver to furthest upriver. The visibility generally decreases moving upriver, although the site with the greatest intervisibility of other sites is midway up the Canyon, DjRi-46, the site furthest up the Canyon, has visibility to DjRi2(N) but the visibility is not reciprocal.

The results of the visibility analysis indicate that there was not a complete, connected model of intervisibility between rock feature sites throughout the Lower Fraser River Canyon, based on current available data. In the downriver portion of the Canyon, there is good intervisibility between sites, so communication between them for various purposes would have been possible. Further up the Canyon, however, this network appears to break down, as the sites upriver have little intervisibility, precluding some forms of intersite communication. In fact, there are two clusters of intervisibility: the sites in the southern portion (DjRi-14, 21,13, 62) and the sites in the northern portion (DjRi-2(S), 2(N), 46). The topography of the upper half of the Canyon may

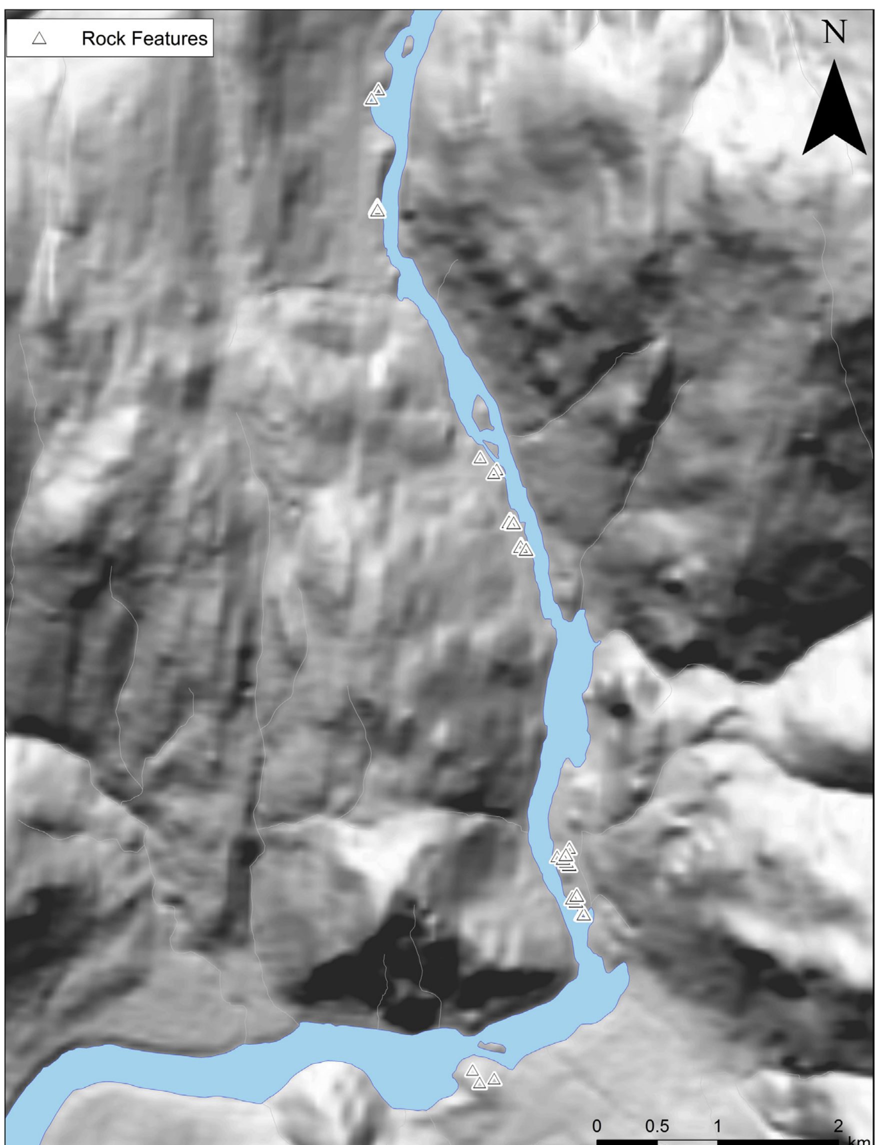

Fig. 7. Location of rock features in the Lower Fraser River Canyon.

have prohibited intervisibility, but it does not appear that sites were selected or rock features constructed to emphasize the intervisibility locations in the upper Canyon. It is possible that other means of signalling could have been used, but current analysis suggests sites are not connected via line-of-sight (*contra* Schaepe, 2006). An emphasis on intervisibility at the entrance to the region suggests that monitoring movement into the Canyon may have been more important than monitoring movement within the area. Data from the site at the entrance, DjRi-14, supports this hypothesis, as it contains the greatest number of rock features clustered at any site within the entire region, has the greatest viewshed, the largest area, and is ideally situated to control entrance to the Lower Fraser River Canyon (see Schaepe, 2001, 2006 for a discussion of this important site).

5.2. View from the river

Rock features at or adjacent to village sites in the Lower Fraser River Canyon were used to provide the data for evaluating which rock features can be seen by travellers on the river from the downriver direction (Fig. 7). The sampled sites do not represent all areas with rock features in the Lower Fraser River Canyon but provide an insight into those places where rock features cluster around known villages. A total of 25 mapped rock features were included in the analysis. Table 2 summarizes the visibility of rock features from the river by site, moving from downriver to upriver. Rock features were considered visible if they fell into a cell that had a value of 1 or greater in the viewshed (Fig. 8).

Some patterns emerge from the results. First, a slim majority of rock features are visible from the river ($n = 13$, 52%). Rock features, therefore, were not built exclusively to be seen by outsiders. Nearly half of the sampled rock features ($n = 12$, 48%) at village locations in the Canyon were constructed in areas that would not have been visible to people until they disembarked and entered village site locations. At the downriver end of the Canyon, rock features are more likely to be visible than rock features at sites further upriver. This result suggests that rock feature visibility was a greater concern at the entrance to the Canyon and these particular rock features were more likely to be built in ways to ensure visitors could see them.

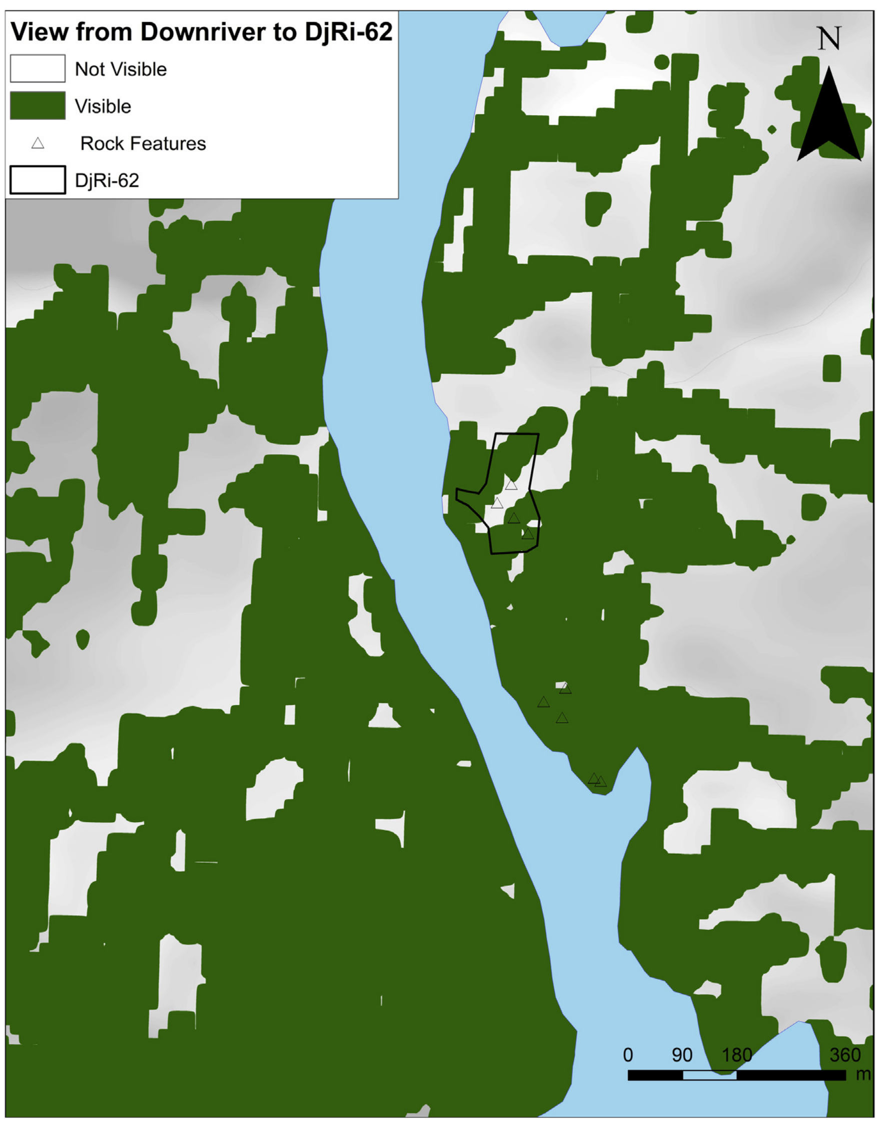

Fig. 8. River viewshed example.

Table 3
Rock features visible from the river, showing times seen.

Feature	Type	Volume (m3)	100 m	500 m	1000 m	2000 m	Over 2000 m	Total times seen
RF-T01	Terrace	26.2	1	0	0	0	1	2
RF-T02	Terrace	35.79	1	0	0	0	0	1
RF-T06	Terrace	3.06	2	0	0	0	27	29
RF-T07	Terrace	12.89	0	0	0	0	27	27
RF-T21	Terrace	213.96	1	3	0	0	0	4
RF-T63	Wall	41.48	1	0	0	0	0	1
RF-T68	Terrace	197.88	1	0	1	0	0	2
RF-T69	Terrace	97.51	1	0	0	0	0	1
RF-T73a	Terrace	382.12	0	1	1	2	0	4
RF-T73b	Terrace	368.97	0	4	23	0	0	27
RF-T76	Wall	74.13	0	0	0	11	6	17
RF-T85a	Wall	13.55	4	2	0	0	0	6
RF-T85b	Wall	10.41	4	2	0	0	0	6

Examining the visibility of rock features at different distances allows for a more refined analysis (Table 3). Rock features that could only be seen within a 100 m or 500 m distance from a village may have had a different impact on travellers through the territory than rock features that could be seen from a kilometre or more away. Within the 13 features that can be seen from the river, three can only be seen by a traveller within 100 m of the site. Features only visible with 100 m include RF-T63, a hypothesised defensive

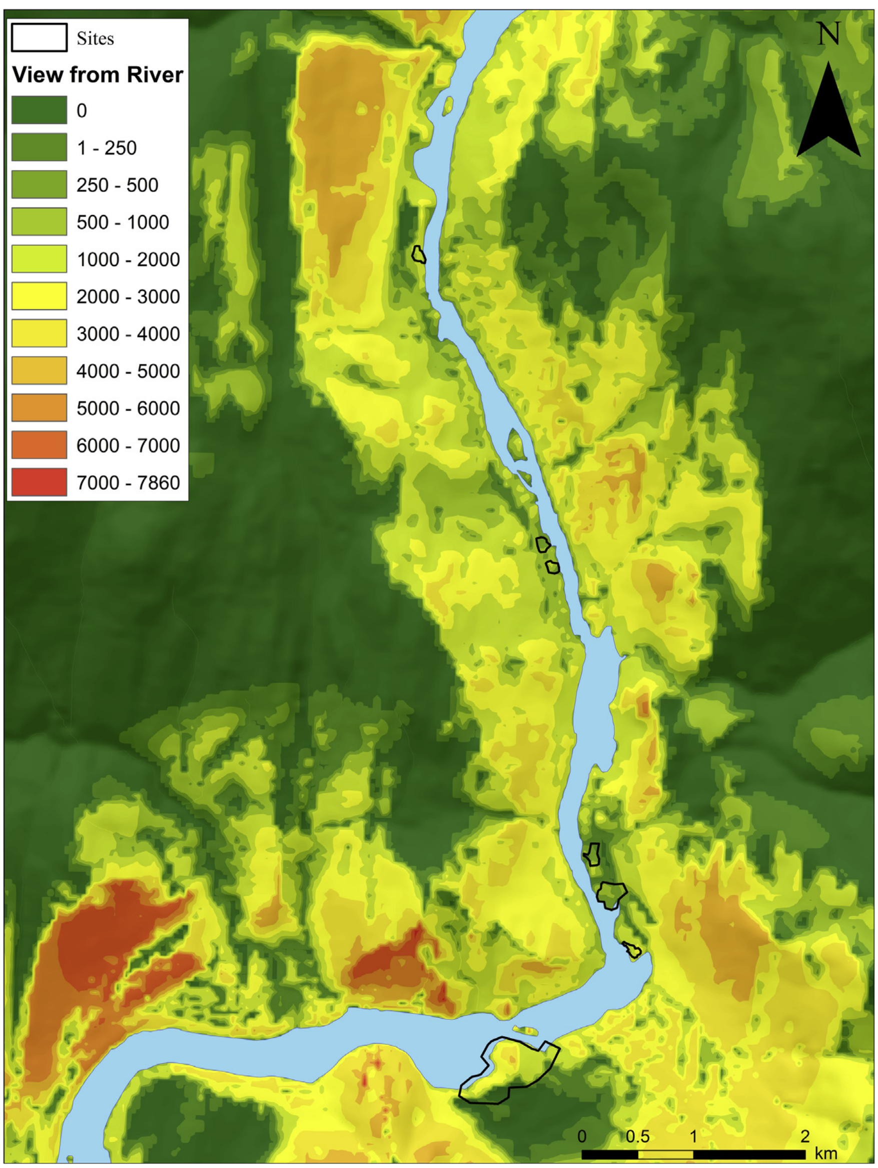

Fig. 9. River view to sites.

structure, indicating that this feature may have been built to conceal village defenders or serve a different purpose. An individual looking out from this location would have had a broad view downriver, making this an ideal location for a lookout where you can see what is coming but not be seen.

Four features can only be seen from distances greater than 100 m of the site, while one feature (RF-T07) may have only been visible from beyond 2 km away from the site. RF-T07 is a small rock feature. Due to the use of local materials with similar characteristics as the surrounding landscape, it is unlikely that this feature could be discerned from the natural landscape at a 2 km distance. No rock features are visible from all distances. Four of the rock features could have be seen by a traveller approaching the site from downriver more than ten times as they moved through the landscape, with a tendency for larger number of times seen further away from sites. This is not surprising, considering the increased area included in buffers beyond 1000 m. Nevertheless, seven sites can been seen from 1 km or more downriver, suggesting an emphasis on building some forms of rock features to be seen from a distance on the landscape. Rock features built to be seen could have played a symbolic purpose of both welcome and warning to people travelling into the Canyon for friendly and non-friendly interactions.

Another method of testing whether village sites and rock features were placed in highly visible areas, as measured from the river, is to compare their placement against the surrounding terrain. If the rock features were deliberately placed to be seen, they should be placed in areas of greater visibility than the rest of the landscape. If the rock features were meant not to be seen, they should be placed in areas of lesser visibility than the rest of the landscape. A viewshed was run from all river points to the surrounding DEM. The resulting map (Fig. 8) indicates areas of highest visibility from the river. When the villages and rock features are mapped against the river viewshed, it becomes clear that while some are placed in visible locations, areas of highest visibility are not emphasised (Figs. 9 and 10). In addition, a viewshed was run

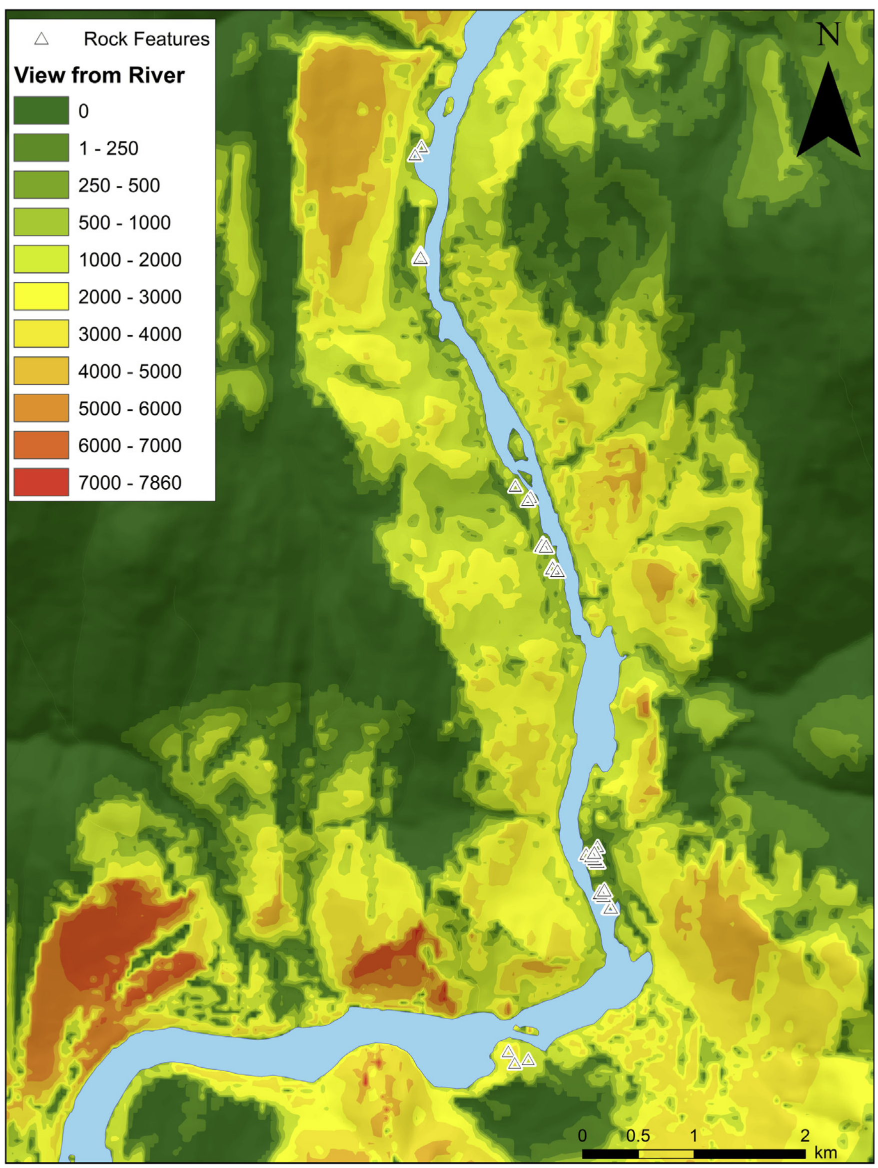

Fig. 10. River view to rock features.

from all points within a 1000 m buffer of the river and both sites and rock features placed on the cumulative viewshed map (Figs. 11 and 12). Based on this analysis, rock features and sites do not seem to be placed in areas with different characteristics than the surrounding landscape. A similar pattern is visible when slope is examined (Fig. 13). Most villages and features are placed on relatively flat areas, but there are other areas with similar slope where rock features and villages are not currently found. Other factors, such as river proximity, likely played an important role in site selection. However, even when looking at areas directly adjacent to the river, the sites were not placed in the areas of highest visibility.

6. Discussion

The results of the two forms of viewshed analysis indicate that neither external nor internal signalling can account for all rock features; instead, variation among the placement of rock features may indicate different purposes for their construction. Landscape features, even if they are of a similar type, cannot be assumed to all play the same function within a cultural group. Rock feature placement demonstrates that a slight majority of sampled rock features are placed in locations where travellers into the territory could have seen them. The remaining sampled rock features are not visible from downriver, pointing to a possible internal focus for these features. Rock features not visible from the river may have been built by inhabitants or close kin to demonstrate their rights to a particular Canyon location to other inhabitants, rather than visitors or outsiders. The possible internal signaling role of non-visible rock features may relate to internal dynamics of power, status, and ownership. A functional purpose may also have been to provide stable bases for plank houses in steep terrain, although a social and a functional purpose for the rock features is not mutually exclusive. At the downriver entrance to the Canyon, rock features are more likely to be visible and sites are more likely to be intervisible, suggesting that signalling both between sites and outward toward travellers was more important at the entrance to the Canyon than further upriver. The greater visibility of features at the entrance may be related to geographical difference, but inherent landscape factors, including overall visibility of the location and slope of the surrounding area do not seem to have played a significant role in

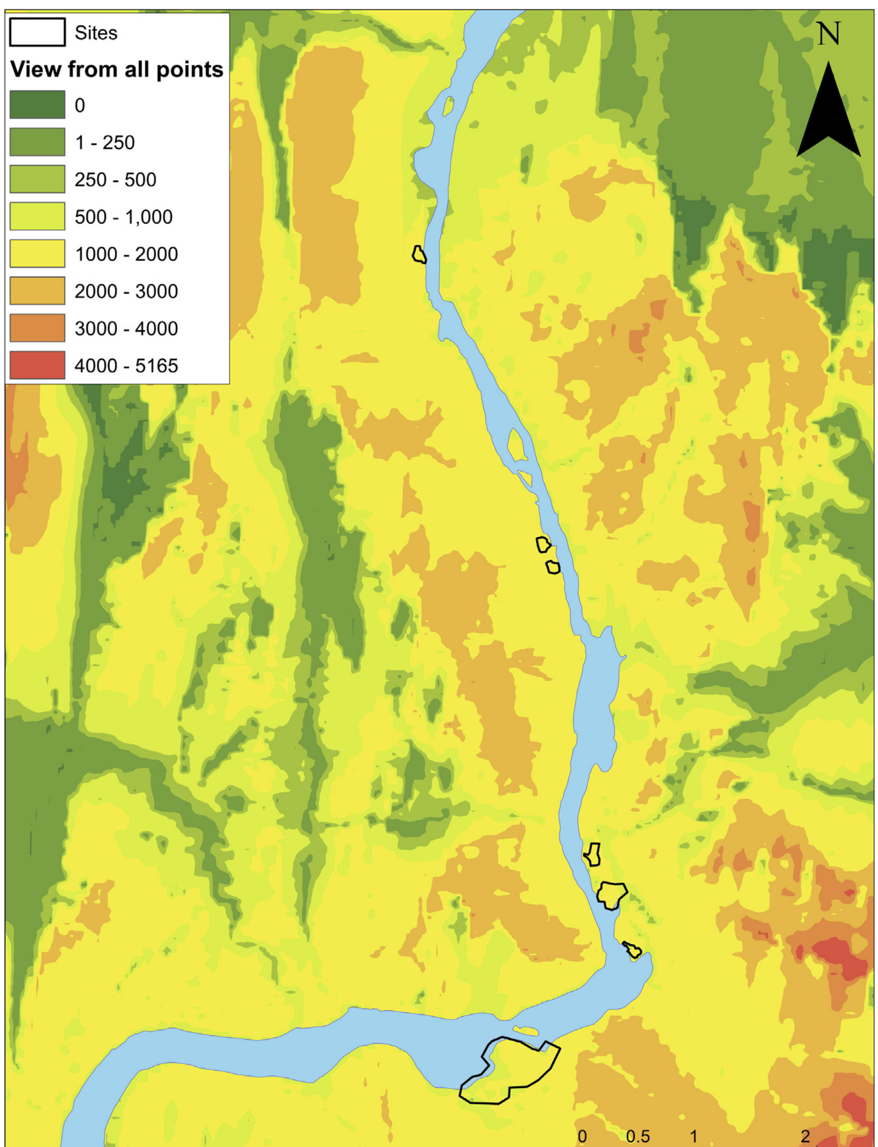

Fig. 11. View from all points within 1000 m of the river to sites.

rock feature placement (Figs. 9–13). However, the analyses presented in this paper are complementary. The different forms of viewshed allow for exploration of possible meanings at different socio-spatial scales within the landscape of the Lower Fraser River Canyon, suggesting that when the connection between built landscape features and the social perceptions of those places are considered, several scales of analysis are necessary, including inside, outside, and in-between.

7. Conclusions

The premise behind the analysis in this paper is that people in the past would have different perceptions of landscape objects depending on their connection to the socio-spatial context in which the features were constructed (Knapp and Ashmore, 1999). Using a case study from British Columbia, a method was proposed to query whether landscape features were constructed primarily for an audience inside or outside the socio-spatial system. Viewshed analyses were applied to test site intervisibility and the overall visibility of features from the Fraser River, the main route of travel through this region. Based on current data, the viewshed results for site intervisibility suggest that visibility was more important at the entrance to the Canyon than further upriver, suggesting an emphasis on ensuring communication between sites when people were entering the Canyon. Moving up the Canyon, fewer sites are intervisible, with an apparent breakdown in intervisibility at upriver sites. More data on sites in the upper portion are needed to evaluate the extent of intervisibility in this region.

To evaluate whether visitors or enemies built rock features in areas that could have been seen, the visibility of rock features from the downriver was tested using a cumulative viewshed. The results of the river viewshed analysis suggest that more rock features could be seen ($n = 13$) than not seen ($n = 12$) from the river. No feature is visible from the full range of downriver distances and several features can only be seen from within 100 m of the site. This pattern, coupled with the near-equal number of visible and not visible rock features, indicate that neither internal nor external signalling was the singular purpose behind building rock feature sites in this

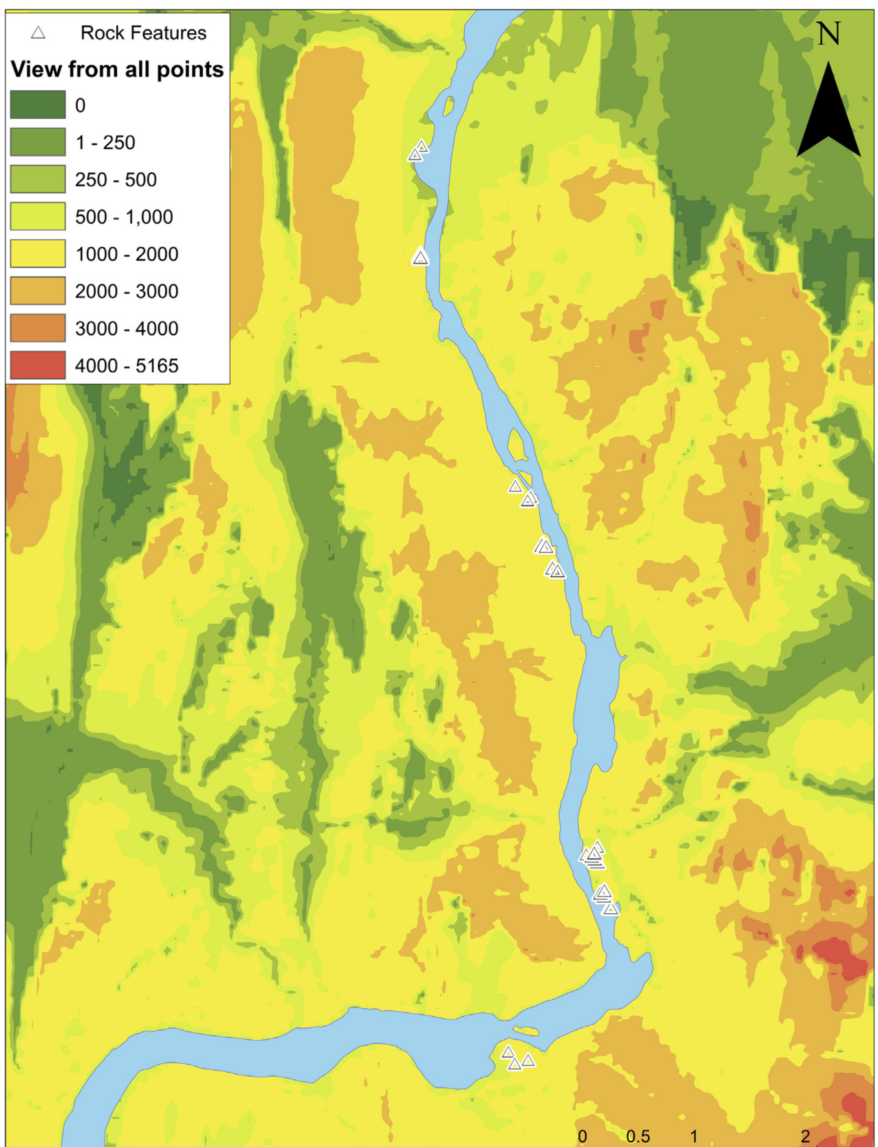

Fig. 12. View from all points within 1000 m of the river to rock features.

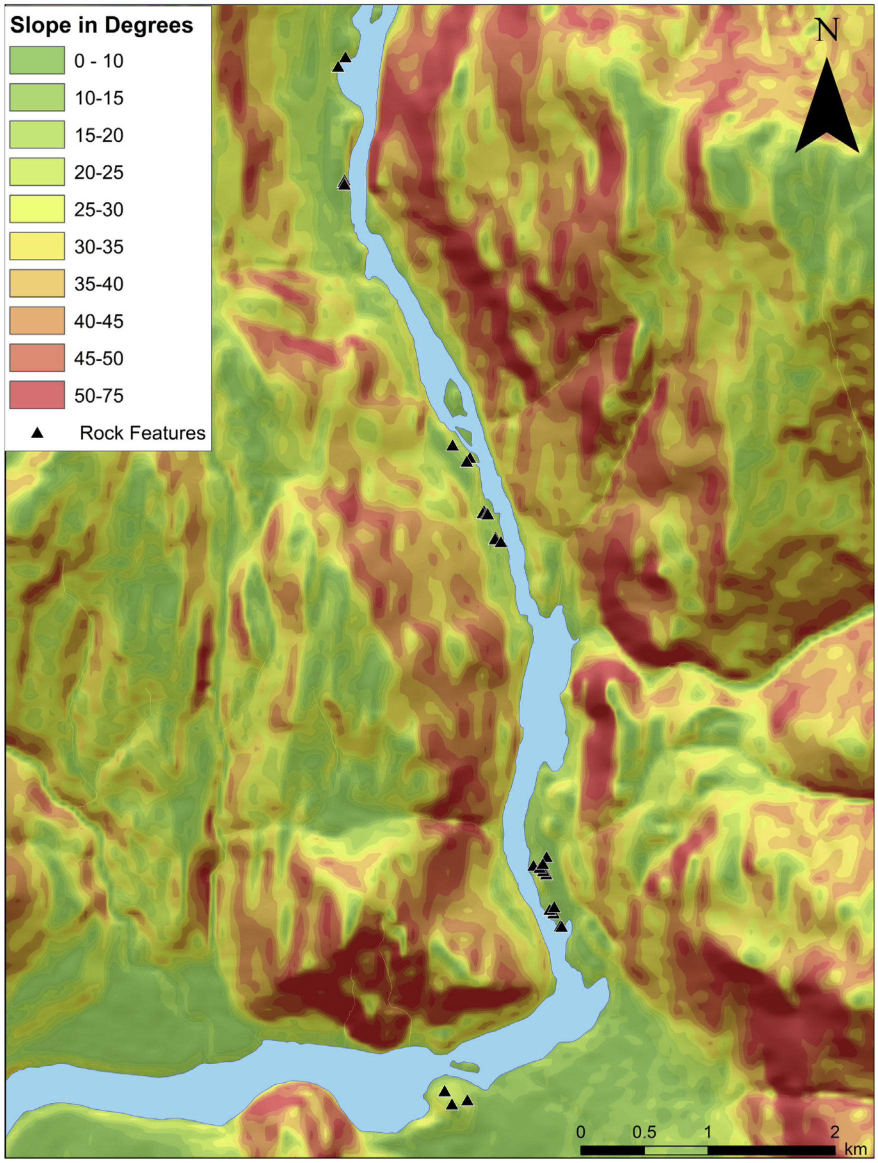

Fig. 13. Slope of the Canyon with rock feature locations.

region. Without this form of analysis, all the rock features could be assumed to have similar functions or audiences. Data presented in this paper suggests that rock features had multiple roles within the socio-spatial system. The method demonstrates how viewshed can be applied to different perspectives on the same landscape and illuminates the complexity of built landscape modification in the past.

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